

Appl. No. 10/799,625
Amendment dated: January 26, 2005
Reply to OA of: September 27, 2004

Amendments to the Specification:

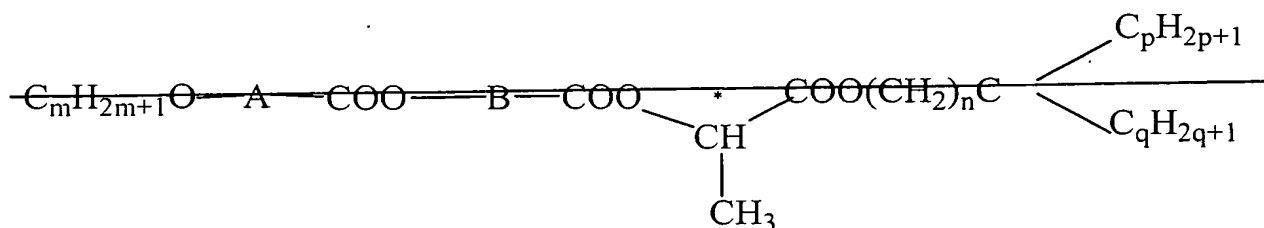
Please replace the original Abstract with the new Abstract found on a separate sheet at the end of this paper.

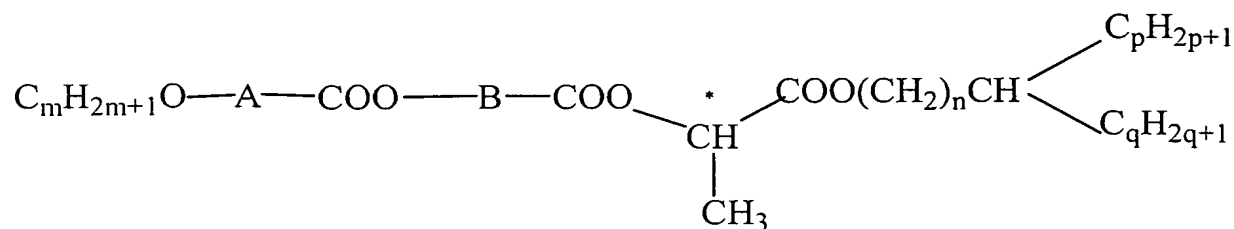
On page 2, please replace the first full paragraph with the following amended paragraph.

Furthermore, it has been proven that achiral materials with swallow-tailed groups have S_mC_{all} phase at antiferroelectric-like structure. Chiral materials with swallow-tailed groups, (S) EP10PBNP, is derived from chiral (2S)-2-(6-hydroxy-2-naphyl)propionic acid which has 2-ethylpropanol as swallow-tailed group, and its anti-ferroelectric property has been proven.

Please replace the last full paragraph which bridges page 3 with the following amended paragraph.

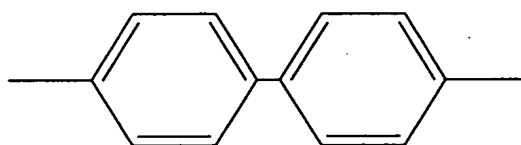
To achieve the object, the present invention provides a series of chiral (L)-lactic acid-based materials with chiral swallow-tailed group. The swallow-tailed group is alkanol. The swallow-tailed material with optic activity of the present invention comprises the following formula (I):



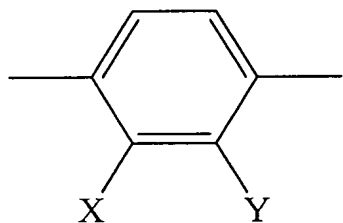


(I)

wherein A, B independently are



, or



; X, Y independently are fluorine (F), hydrogen (H) or chlorine

(Cl); m represents an integral from 6 to 18; n represents 0 or 1; p represents 1, 2, 3 or 4; and q represents 1, 2, 3 or 4.

On page 3, please replace the paragraph after Brief Description of the Drawings which includes the descriptions of FIG. 1 through FIG. 7 bridging page 4 with the following amended paragraph.

FIG. 1 is a diagram of phase transformation temperature versus end chain length (m) of compound I (m, 2, 2) of the present invention.

FIG. 2 is a phase transformation diagram of compound I (10, 2, 2) and compound II (10, [[n]]_p, q; [[n]]_p=0, [[2]]_{3~4}, q=2~4) of the present invention during cooling process wherein the chiral terminal group is coupled with linear group or swallow-tailed group.

FIG. 3 is phase transformation diagram of compound III (X, Y) of the present invention wherein the halogen group is substituted with side chain.

FIG. 4 is the spontaneous polarity (P_s) of compound I (m, 2, 2).

FIG. 5 is the spontaneous polarity (P_s) of compound II (10, n, q).

FIG. 6 is the spontaneous polarity (P_s) of compound III (X, Y) and unsubstituted compound I (10, 2, 2).

FIG. 7 is the diagram of transmitting response versus electric field of compound I (10, 2, 2), compound II (10, 0, 2) and compound III (Cl, H), after adding a triangle wave in a 5 μ m cell.

Please replace the Table 2 on page 5 which bridges page 6 with the following amended Table 2.

Table 2 Phase transformation temperature of compound II (10, [[n]]p, q; n=0, [[2]]3~4, q=2~4) and relative enthalpy data

Phase Transformation Temperature (ΔT) ^a										
Compound	Iso	SmA*		SmC*		SmX*		Cr. ^b mp. ^c		
II(10, 0, 2)	●	146.5	●	117.8	●	31.6	●	16.83	●	60.3
I[[III]](10, 2, 2)	●	[5.59]	^d	[0.54]		[4.09]		[19.4]		[45.81]
		120.4	●	105.9	●	21.4			●	82.2
II(10, 3, 3)	●	[3.45]		[0.63]		[13.58]				[34.76]
		101.3	●	85.5	●	21.5			●	38.7
II(10, 4, 4)	●	[9.49]		[2.67]		[18.04]				[32.04]
		89.6	●	69.7	●	20.5			●	48.7
		[1.05]		[0.51]		[17.10]				[36.95]

^aRorded by DSC thermograms at cooling rates of 5 ΔJ min⁻¹

^bCr refers to crystal.

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^cm.p. refers to melting point taken from DSC thermograms recorded at heating rates of $5^{\circ}\text{C min}^{-1}$.

^dFigures in square parenthesis denote enthalpies quoted in Jg^{-1} .

On page 8, please replace the last full paragraph which bridges page 9 with the following amended paragraph.

The electro-optical response data are determined by cross polarimeter wherein the optic axis of the polarimeter and analyzer are respectively parallel to and perpendicular to the smectic layer of liquid crystal cell. FIG. 7 is the diagram of transmitting response versus electric field for compound I (10, 2, 2), compound II (10, 0, 2) and compound III (Cl, H), after adding a triangle wave in a $5[\mu\text{m}]_\text{m}$ cell. The response is highly relevant to the temperature and the frequency. The highest transmittance increases as temperature decreases. The optical switching of compound II (10, 0, 2) at SmC^* phase exhibits typical ferroelectric hysteresis loops when the applied frequency is 0.5 Hz. However, the chiral swallow-tailed compound, such as compound I (10, 2, 2), at SmC^* phase exhibits U-type switching when the applied frequency is 0.5 Hz.

Please replace the last paragraph on page 11 which is a heading which includes the paragraph bridging page 12 with the following amended heading and paragraph.

Preparation example 3-: 1-Ethylpropyl (S)-2-hydroxypropionate (Product 3 (2, 2))

130 mmol of (S)-2-Hydroxypropionic acid and 150 mmol of 3-propanol were dissolved in 30 ml of dry benzene and heated under reflux with Dean and Stark trap. Benzene was then evaporated under vacuum to get residues. The Product 3 (2, 2), 1-ethylpropyl (S)-hydroxypropionate, is limpid liquid (yield: 45%).

^1H NMR (400 MHz, CDCl_3); δ (ppm) 0.84-0.76 (m, 6H, $-(\text{CH}_2\text{CH}_3)_2$), 1.36-1.31(d, 3H, $-\text{CHCH}_3$), 1.55-1.38(m, 4H, $-\text{CH}(\text{CH}(\text{CH}_2\text{CH}_3)_2)$), 3.84(s, 1H, $-\text{OH}$), 4.21-4.15(m, 1H,

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-COOCH₂-), 4.76-4.70(m, 1H, -COOCH(CH₂)₂-).

Please replace the heading beginning at line 11 along with the paragraphs which bridge page 13 with the following amended heading and paragraphs.

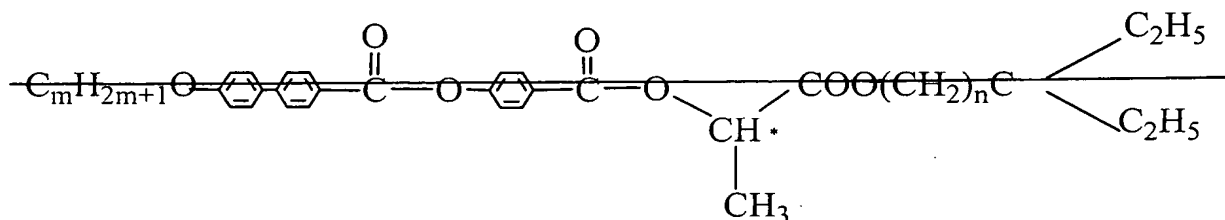
Preparation example 4—: 1-Ethylpropyl (S)-2-[4-(methoxycarbonyloxy)-phenyloxy]propionate (Product 4 (H,H,2,2))

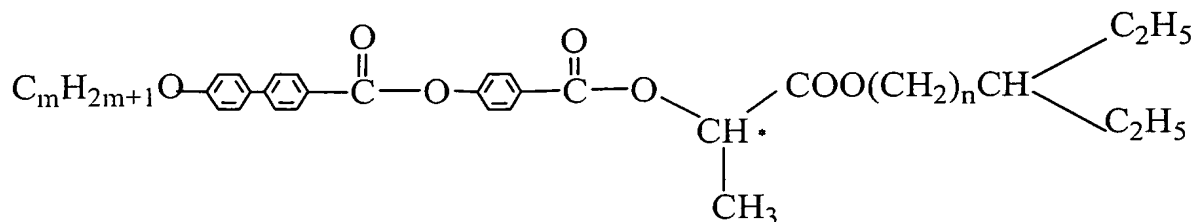
13 mmol of diethyl azodicarboxylate (DEAD) and 13 mmol of Product 2 (H, H) were dissolved in 10 ml of dry THF and then added drop wise to a solution containing 13 mmol of triphenylphosphine (Ph₃P) and 10 mmol of Product 3 (2, 2) in 10 ml of dry Tetrahydrofolate(THF) at room temperature with vigorous stirring and initiated the reaction. Standing at room temperature overnight, the mixture was filtered to remove triphenylphosphine oxide, and THF was removed under vacuum. After checking every step, the product was purified by silica column chromatography and eluted with ethyl acetate/ hexane (v/v=2/8) to obtain transparent liquid Product 4 (H, H, 2, 2) with yield of 75%.

¹H NMR (400 MHz, CDCl₃); δ(ppm) 0.91-0.82 (m, 6H, -(CH₂CH₃)₂), 1.56-1.49(d, 3H, -CHCH₃), 1.62-1.58(m, 4H, -CH(CH₂CH₃)₂), 3.90(s, 3H, -COOCH₃), 4.84-4.80(q, 1H, -COOCH(CH₂)₂-), 5.30-5.27(m, 1H, -COOCHCH₃-, -ArH), 8.12-7.23 (d, d, 4H).

On page 13, please replace the last full paragraph which includes the formula bridging page 14 with the following amended paragraph and formula.

Series of compound 1 has the structure as formula (i):

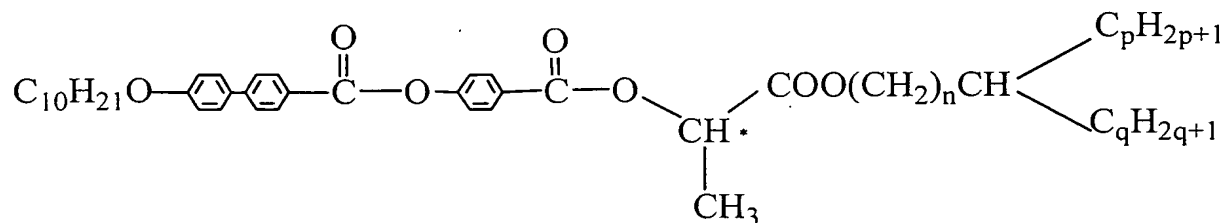
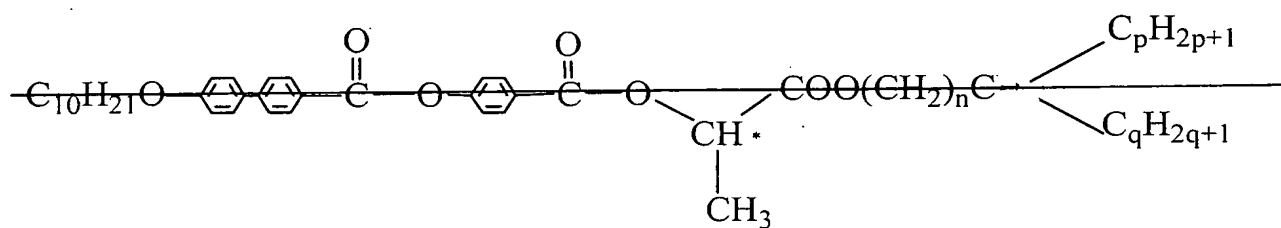




(I)

On page 14, please replace the last full paragraph including the formula (II) which bridges page 15 and includes the Compound III and the formula (III) with the following amended paragraphs and formulas.

Compound II has the structure as formula (II):

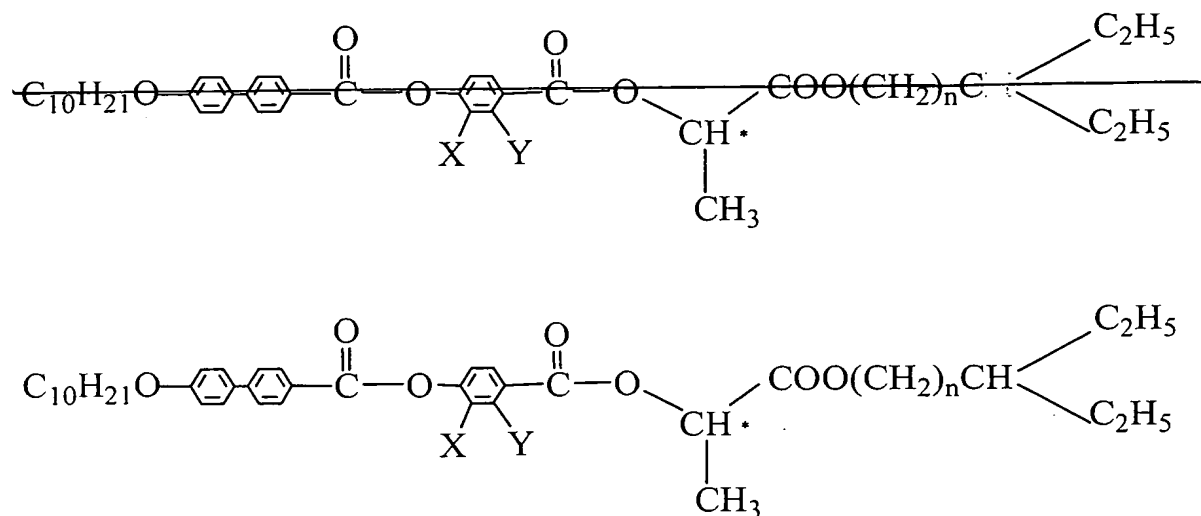


(II)

wherein n is 0 or 1; p is 0, 3, and 4; q is independently an integral of 2-4.

Compound III has the structure as formula (III):

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(III)

wherein n is 0 or 1; X and Y independently are fluorine or chlorine.

On page 15, please replace the paragraph beginning at line 12 with the following amended paragraph.

As disclosed in the above embodiments, the chiral liquid crystal materials of the present invention have broad range of – operation temperature and high ferroelectricity. They can be further used as the precursor of liquid crystal stuffing in LCD.